HISTORICAL

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[redacted] LANL-A

October 13, 1949

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Unique Document #

TO: Technical Council Members

FROM: Edward Teller [redacted]

SUBJECT: THE SUPER BOMB AND THE LABORATORY PROGRAM

ADWD-2-7

On Monday there will be a discussion in the Tech Council concerning the Laboratory program and in particular concerning the question whether our effort can be so increased as to make the Super Bomb feasible within the foreseeable future. I should like to present to you my views on this matter in this memorandum. In this way, I hope that more thought can be given to the question before Technical Council convenes.

I would like to outline why it is essential for us to develop a Super Bomb at the earliest possible time or else be able to say with reasonable confidence that the Super is not feasible. The arguments that have led me to this conclusion are of various kinds.

POLITICAL CONSIDERATION: [redacted]

It is my conviction that a peaceful settlement with the Russians is possibl only if we possess overwhelming superiority. We do not now possess such superiority. The most promising prospect to acquire a great lead is by an early development of a Super Bomb. I am sure that such an accomplishment will in itself not solve the problem. Most difficult political questions will also have to be solved. But early possession of the Super Bomb will give us another chance in the political field. Without a Super Bomb such another chance is not likely to arise.

RUSSIAN PROGRESS:

The fact that an atomic explosion took place in Russia at this early a date has considerable significance. It seems that the Russian rate of progress is at least comparable to, if it does not exceed, the rate of progress in this country. The Russians have started working on the atomic bomb approximately in the summer of 1945. They are likely to have given consideration to the problem somewhat earlier but it is hardly probable that the total time of reasonably intensive effort in Russia has exceeded five years. This time is approximately the same as the time that was needed in this country to make and to explode an atomic bomb. Thus the rate of progress in R[redacted] is comparable to the rate at which we have been working during the [redacted] present rate of progress in comparison is far slower than in war[redacted].

It is probable that the Russians did not explore as many po[redacted]es before achieving an atomic explosion as we did. It is also pro[redacted] the Russians have not put into their atomic development th[redacted]orough and elaborate scientific and technical effort as we did. [redacted] therefore claim that their accomplishment is not equal to our wartime a[redacted]omplishment. If this is so, however, it merely proves that the elaborate precautions which we took in our atomic development was not absolutely essential. If the

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Russians continue to make actual progress faster and if we lose the atomic armament race, it will make little difference whether the reason has been the particular brilliance of Russian scientists or the exaggerated caution and thoroughness of our own group. [redacted]

A detailed possible picture of the Russian progress can be imagined along the following lines:

The Russians probably were familiar with the plans for the Canadian heavy water pile. The captured German scientists also knew of plans for heavy water piles. There are two major technical difficulties in the construction of such a pile. One is the fabrication of metallic uranium. This the Russians have probably learned from the Germans. The other is the production of great quantities of heavy water. There are several ways to accomplish this. One of the best techniques is the distillation of liquid hydrogen. The necessary low temperature technique is quite well developed in Russia. The Russians may therefore have had a pile of the approximate efficiency of the Chalk River pile as early as 1948 or even 1947. The extraction of plutonium from such a pile is a difficult job but can be more easily accomplished if the precautions taken for protection of personnel are less elaborate than those taken in this country. Such precautions are and must be a paramount consideration in our country but the same is not the case in Russia. A pile of the Chalk River type working steadily at 30 megawatts can produce material for a trinity bomb in less than a year. It can produce material for a gun gadget in two years. It is quite possible that the Russians have made a successful implosion. It is also possible, although perhaps somewhat less likely, that they have used the gun assembly and that the actual nuclear explosion was performed with a relatively inefficient gun gadget.

The above description gives the Russians credit for a minimum of scientific and technical progress. Even if this minimum is accepted, further Russian progress can be anticipated along the following lines. The Russians probably will build further heavy water piles. They may also build small piles working with some of the plutonium which the heavy water piles produce. These aims can be rapidly accomplished if no excessive demands are made with respect to high flux, resistance of materials for irradiation or with respect to breeding properties. The Russian rate of production of plutonium may equal the rate of our production within a year and indeed we have no absolute assurance that our production has not been already surpassed. It is therefore not impossible that the Russians should overtake us even in the matter of the stockpile which is the one item which never has been neglected in the United States.

An even more dangerous situation seems to exist with respect to neutron excess. This neutron excess is much greater for heavy water piles than it is for graphite piles and of course even greater for plutonium piles. T[redacted]t is reasonable to assume that the Russians either are already ahe[redacted]n this respect or will be ahead of us in the near future.

The number of available excess neutrons is of decisiv[redacted] in several war time applications of atomic energy. [Among the[redacted]duction of tritium is probably the most important since tritiu[redacted]uction is an important component in the production of the Super Bomb.]

DOE 6(3)

One of the first objectives would be to step up the date on which one can hope to produce a successful booster.

TIME SCHEDULE:

If the Laboratory can marshall the necessary support from Washington for a really vigorous program, the problem of construction and detonating of a Super might be attacked with the same speed with which similar problems were attacked during the war. I realize that this program calls for an all out effort. However, I do not believe that anything less than such an all out effort would be commensurate with the responsibility which this Laboratory has undertaken with respect to the ultimate safety of the nation. It will be essential that all members of the Laboratory contribute fully any ideas they may have how to accomplish the technical details of this job.

[redacted]

[redacted]

This document consists of 71 ~~44~~ pag
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T-638

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October 1, 1954

THERMONUCLEAR WEAPONS

Period 1946 to January 1950

(Draft version of a section for a history of technical work at Los Alamos since the war)

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[redacted]

L. Nordheim: one month in 1947; brief visits in early 1949 and 1950; full time September, 1950 - September, 1952.

E. Teller: nine months between July, 1946, and June, 1949; full time from July, 1949, to October, 1951.

J. von Neumann: two months per year on the average (between one and three months each year) from July, 1946, to December, 1953.

J. A. Wheeler: full time from March, 1950, to June, 1951; after which continued to be heavily engaged in the program through Project Matterhorn until March, 1953. Two months at Los Alamos, July - August, 1953.

(ii) Project Matterhorn. In July, 1951, J. A. Wheeler established and directed at Princeton a group known as Project Matterhorn to engage in the program of theoretical studies of thermonuclear weapons in the form then being considered. This group worked in collaboration with the work at Los Alamos. After the formation of the Livermore Laboratory, it made plans to discontinue its operation and the contract was formally terminated on March 1, 1953. Several members of the Project continued work on the terminal and summary reports of Matterhorn work into the summer of 1953. (The present Project Matterhorn, working under L. Spitzer on the problem of controlled thermonuclear reactions, began its work about the same time and was originally called Division S of Project Matterhorn. It was operated under direct contract with the AEC and continued administratively unaffected by the termination of the group engaged on weapons studies.)

[redacted]

(In the following section, the progress of work along a number of specified lines will be traced across this period, and some of the items merely referred to in the present listing will be discussed further.)

May-September, 1946: All the individuals engaged on the studies and calculations discussed at the Conference wind up work underway at that time and prepare final reports, with the exception of Landshoff, who remains at Los Alamos and continues studies of the properties of detonation waves in pure deuterium. (Landshoff remained at this problem until summer, 1947.) From mid July to end of September, Hoyt works on same problem.

September, 1946: Teller proposed the system called the "Alarm Clock," and Richtmyer takes up problem of estimating performance.

October, 1946: Evans takes up study of detonation in deuterium.

November, 1946: LA-610, first Alarm Clock report issued by Richtmyer. Report contains arguments of feasibility in principle, and rough estimates of efficiency and behavior.

December, 1946-January, 1947: Landshoff, Mark and Richtmyer make estimates (embodied in LAMS-560) for use of deuterium (or deuterium and tritium) placed close to the core in a fission bomb test to check predicted features of thermonuclear burning.

[redacted]

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January-February, 1947: Richtmyer starts to develop an improved theory of efficiency of Alarm Clock. Discussion with Teller and von Neumann of possible application of advanced electronic computing equipment (then in early stage of design at Princeton) to Los Alamos problems.

February-March, 1947: Studies of equation of state and related problems, pertaining to thermonuclear as well as fission devices, reactivated at Los Alamos as H. Mayer joins staff. "Monte Carlo" method of computation proposed by Ulam, and LAMS-551, outlining prescription for application of method, prepared by von Neumann, with additional suggestions by Richtmyer.

March-April, 1947: With Teller, planned program for summer, 1947, primary objectives being to: continue studies of detonation in deuterium and Alarm Clock, develop Monte Carlo method, initiate work on obtaining method of calculation of radiation flow in exploding fission bomb, study the proposed experiment to check ideas on thermonuclear burning, and prepare status report on thermonuclear systems. (This last resulted in LA-643, September, 1947.)

May-June, 1947: LA-636: "Improved Theory of the Alarm Clock," issued by Richtmyer.

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[redacted]

July, 1947: Nordheim joined Richtmyer in study of Alarm Clock.

August, 1947: Efficiency calculations for a number of possible Alarm Clock configurations completed with the scheme worked out in LA-636. Landshoff takes up work on radiation flow in fission bomb.

September, 1947: Further Alarm Clock examples calculated (LAMS-625). LA-643[(5)] issued.

(As the thermonuclear principles involved in the Booster were not essentially different from those embodied in LAMS-560, consideration of the Booster soon superseded further consideration of the LAMS-560 type of proposal.)

October, 1947: Richtmyer starts to plan a fully-detailed machine calculation of the course of a fission explosion. (This turned out to be a two year program, and the first example was actually calculated only early in 1950.)

December, 1947: Work started separately by Landshoff <u>et al</u>. on simpler and, hopefully, faster fission explosion calculation. (Since Richtmyer's problem came to be known as

(5) LA-643: "On the Development of Thermonuclear Bombs." (September 30, 1947.) Written by: E. Teller; Word done by: F. Evans, F. Hoyt, R. Landshoff, M. Mayer, L. Nordheim, R. Richtmyer, E. Teller, E. Zadina.

 [redacted]

[redacted]

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"Hippo," the work by Landshoff was known as "Baby Hippo.") Preliminary consideration given to preparing a detailed calculation of the propagation of burning in deuterium for handling on the electronic computer expected to be completed at Princeton within a couple of years.

January, 1948:

DOE
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(From January through April a considerable amount of effort was required in connection with preparations for the Sandstone tests and consideration of results.)

February, 1948: First automatic machine calculation of Monte Carlo type prepared for handling on the ENIAC. (Monte Carlo calculation techniques were expected to be required in the detailed calculation of deuterium burning, as well as other types of problems.)

March, 1948: Richtmyer (and von Neumann) introduce so-called "viscosity treatment" of shocks, LA-671. (This technique, which was devised to meet needs arising in connection with Hippo, reduced the problem of calculating

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[redacted]

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the progress of shock fronts in explosion (and implosion) calculations to manageable proportions on automatic computing machines, and was of profound value in very many of the calculations undertaken subsequently.)

July, 1948: Detailed study begun of behavior of a Booster system (considered either as a test of thermonuclear principles or a possible weapon). Work begun on equation of state of paraffin (wanted in connection with possible experimental gadgets to test ideas in the thermonuclear field).

August, 1948: Study of the scattering of neutrons by light elements to obtain data required in connection with various calculations (Booster, hydrides, and deuterium burning).

September-October, 1948: LA-704, [redacted] Also LA-713, "Further Booster Calculations." These were the first detailed studies relevant to the proposal to test such a device in the tests then scheduled for 1951. [redacted] From this point on, the planning

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JDWO-79-5 [redacted] April 27, 1979

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The Relationship Between Nuclear Weapon Testing And Stockpile Reliability: The Los Alamos Experience

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[redacted]

RESTRICTED DATA

The report also stated that "the study should present the judgment of the directors of the laboratories responsible for assessing and or qualifying the reliability of nuclear weapons on the potential importance of conducting nuclear detonations for establishing and maintaining confidence in the reliability and performance of those weapons." The statement submitted by Dr. Harold M. Agnew for inclusion in the joint report to the Senate is attached as Appendix B.

In response to the Senate request, the weapons laboratories were tasked by DOE Military Applications (MA) to identify all nuclear weapon tests relating to the reliability of the weapons in stockpile, both past and present. Those tests were to be broken down into six categories. Definition of the categories has of necessity been adjusted during the study. Summaries from both LASL and the Lawrence Livermore Laboratory (LLL) have been combined to provide the basis for the joint DOE-DOD report to the Senate Committees.. Only a tabular numerical summmary was used in that report; the purpose of this document is to provide the detailed backup tabulation, weapon by weapon and test by test, on which the LASL numerical summary, submitted in November 1978, was based. The tabulations presented here are augmented versions of those that were used earlier.

Because of the stringent ground rules we established, many tests that contributed to technology development, but not directly to a stockpiled weapon design, were not listed in the compilation, nor were many LLL tests that contributed in some way to the LASL technology base (e.g. Surfer tests). The synergism among all tests should not be overlooked.

The results of the study are presented, first, in the form of aggregate numerical summaries in which total numbers of tests and of test-weapon interactions before and after final proof tests are displayed; second, in the form of a tabular numerical summary of tests in each of the six categories for every LASL weapon (the form in which the study results were provided to MA for the Senate report); and third, in the form of the detailed backup tabulation that lists all tests as they relate to each weapon. To aid readers having varied objectives, the backup tabulations have been listed in several ways: by weapon number in numerical order; chronologically; and alphabetically by event name.

The reason for the first (phase 5) is that on some occasions tests have employed devices finally proof-tested but for which the FPU had not been delivered. The reason for allowing gas-fill changes is that this happens between proof-test and production specification with some regularity.

5. Stockpile-type primary tests. These tests involved nuclear components equivalent to those in the stockpile primaries, but they may not have been fabricated entirely in the WR production complex. Any primary test not in Categories 2, 3, or 4, subsequent to the primary proof test, is counted in this category. Again, gas changes did not disqualify otherwise valid tests.

6. Vulnerability and effects tests. The purpose of these tests is to gather fundamental information on system and component response to hostile environments, to develop hardening procedures and verify their effectiveness, and to satisfy requirements that the weapon system will operate satisfactorily despite hostile attack as defined under stockpile to target sequence conditions. Such tests are a vital factor in assessments of stockpile reliability. Other effects tests that do not fall in the V&E category are included by placing them in other appropriate categories, when they involved a WR or stockpile-like weapon.

AGGREGATE NUMERICAL SUMMARIES

(A) Actual test events (explosions)

For the case of actual test events (explosions) it is not convenient to separate the events according to whether the weapon affected by the test had or had not been retired from the stockpile, because many tests affected both kinds of weapons (weapons now retired were affected during their stockpile life by tests that also were related to weapons still in the active inventory). However, total event numbers in each category for all weapons, retired as well as current, are tabulated in Table I.

TABLE I

TEST EVENT SUMMARY

Category 1:	197
Category 2:	28
Category 3:	2
Category 4:	20
Category 5:	55
Category 6:	25

These numbers when totalled exceed the actual number of events (276) because 36 events appear in two categories, six in three categories, and one in four categories.

(B) Test-weapon interactions

We can also summarize the numbers in each category that represent test-weapon interactions; a single test may have had implications regarding the design - or confidence in the design - of several weapons. This summary is obtained by totalling the following detailed tabulations, and is more relevant than bare event numbers when one is assessing the extent to which post-proof-test experiments have contributed to stockpile confidence. The result is given in Table II.

TABLE II

TEST INTERACTION SUMMARY

Category 1:	298
Category 2:	35
Category 3:	2
Category 4:	21
Category 5:	85
Category 6:	38

In contrast to the event summary, the interaction summary can be separated into numbers for retired and current inventory. The total number of test-weapon interactions in categories 2 through 5 (that is, post-proof-test experiments) for the 26 retired LASL weapons is 55; the same total for the active inventory of 18 LASL weapons is 88. The largest single category in the post-proof-test set is Category 5, with 85 entries, of which 51 involve primaries of weapons still in the active inventory.

WEAPON-BY-WEAPON NUMERICAL SUMMARY

The numbers of tests in each category for every LASL weapon are presented in Table III; retired weapons are identified by the letter R.

TABLE III

NUMERICAL SUMMARY OF TESTS OF ALL LASL WEAPONS

DOE b(3)

for very few weapons (e.g. the LLL W62 MMIII warhead), but several are planned in the near future.

BACKUP TABULATIONS

The detailed data base from which the numerical summaries were drawn is presented in tabular form. As noted earlier, the tabulations are listed in three ways: by weapon number in numerical order (Table IV), by date of the test events (Table V), and alphabetically by event name (Table VI).

Many tests contributed to the development or post-development assessment of reliability of several stockpile weapons and therefore are listed repetitively; to facilitate the counting process, each test is identified by an asterisk in the date column the first time it appears in each listing. The Greenwich Civil Time of each event is given as yymmdd, where yy is the last two digits of the year, mm is the month, and dd is the day. In Category 1, entries X, X1, or X2 in the development or proof columns indicate that the test was relevant to the entire weapon, the weapon primary, or the weapon secondary, respectively.

DOE b(3)

The COMMENTS on V&E tests generally describe the components exposed. The column headings for each category carry a mnemonic aid as follows:

Category		
1	D	Development
1	S	Safety
1	P	Proof
2	WRW	War Reserve Weapon
3	WRP	War Reserve Primary
4	RW	Reliability of the Weapon
5	RP	Reliability of the Primary
6	V&E	Vulnerability and Effects

In the COMMENT field of the tables, the word EFFECTS has been included if the shot was a DOD or joint DOE-DOD effects test; Category 6 (V&E) events may or may not have this indication. The identification of effects tests was a requirement of the original DOE/MA request that led to this report. The letter F in the COMMENT field indicates that a shot was a clear failure.

Other comments listed were limited by the space available and are primarily of use to the compilers. In many cases the shorthand used is not self-explanatory. No attempt was made in the comments to systematically describe the purpose of each test.

The initial version of the tabulation, JDWO-78-27, contained information about the diagnostic measurements made on each test, in order to allow a judgment regarding the test's contribution to knowledge about the characteristics of the test device. The diagnostic information is omitted from this listing, but it may be included in future versions. In any case, the information is available.

It is not unlikely that the tables will require revision in the future, but we expect such revisions to be minor. Periodic updating may be desirable if the document is considered to have intrinsic value beyond its original purpose.

Compilation of the data base was not straightforward. A basic reference was the Test Information Index published by the Defense Nuclear Agency (HQDNA 119M-11, 15 November 1977), but that document alone was insufficient for the task. Also helpful were the DNA Nuclear Weapons Characteristics Report (HQDNA-48M, 15 July 1978) and A History of the Nuclear Weapons Stockpile, FY 1945 to FY 1975 (USERDA, TID 26990, August 1976). However, using these as basic guides, it proved necessary to exhaustively comb the sources of local documentation and the memories of participants in the weapon program to establish what we believe is a consistent list of all tests in each category for every weapon. The tabulations maintained by B.A. Wellnitz were indispensable to this task.

JDWO-79-5
Appendix B

April 27, 1979

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

REPLY
REFER TO:
MAIL STOP: 100

November 17, 1978

MajGen Joseph K. Bratton
USDOE/MA
Germantown, MD

Dear General Bratton:

The Senate Committee on Armed Services have asked me to express my judgment "on the potential importance of conducting nuclear detonations (nuclear tests) for establishing and maintaining confidence in the reliability and performance" of nuclear weapons currently and formerly in the U.S. arsenal. I am happy to do so.

I should state at the outset that I believe that the nuclear weapons we now have in the U.S. stockpile are entirely reliable. We initially acquired this high confidence in the performance of each nuclear weapon as a result of the careful testing we conducted to certify the correctness of the designs. At present there is a large body of data from our continuing test program that allows us to maintain that confidence. I shall summarize some of the relevant information later in this letter. The importance of this data base cannot be overemphasized, although few outside observers seem to be aware of its existence. Thus the phrase "reliability testing" is often misused, in that its meaning is frequently limited to the description of tests in which weapons are literally extracted from the stockpile and fired to see whether they will go off with the right yield. That is almost never done, for reasons that will become clear, yet testing is absolutely essential to our continued high confidence in the reliability of our weapons.

Before I turn to the specific data base that supports our confidence in the stockpile, past and present, let me review again briefly the overall importance of the continuing test program: (a) The test program increases our understanding of nuclear weapon physics, which remains incomplete even after many years of theoretical and empirical study; (b) It maintains the competence of weapons designers and engineers so that they can provide professional judgments when questions arise - as they do - about stockpile weapons, or when those weapons must be rebuilt; (c) It allows the discovery as well as in some cases the resolution of problems in the stockpile. As I have said many times, I do not believe that the weapons technology base, on

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An Affirmative Action/Equal Opportunity Employer which our confidence in the stockpile ultimately rests, can be maintained indefinitely without the essential empirical element provided by nuclear testing. If testing is halted - without the clear and assured prospect of resumption within a very few years - a rapid decline in our ability to make correct judgments about the stockpile is inevitable. Stockpile maintenance is a dynamic, not a static process. There will be pressures to make "minor" changes in stockpiled systems that will force design judgments. We will be unable to confirm the validity of those judgments by testing. This will either lead to a significant loss of confidence over the years or, alternatively, false confidence that is a result of our growing ignorance about what can and cannot be done with nuclear weapons.

It is clear that there is an important synergism among all of the tests that we do. Equally - if not more - important, however, to our confidence in the reliability of the stockpile are the many tests that involve either key nuclear components of weapons in the stockpile or the stockpile weapons themselves. Such tests are not, in general, performed because of misgivings about weapon reliability; they may be weapon effects tests, seismic calibration tests, operational system tests, or tests serving a number of other primary purposes. In the process of achieving their primary objective, however, they additionally provide confirmation that the weapon or key weapon component used in the test does function properly. This is not accidental - most tests of this kind call for sources having predictable characteristics, and the sources we know best reside in the tested stockpile. Every such test is in a real sense a reliability test, and it is against the background of these tests that the relative infrequency of "reliability tests," narrowly defined, must be examined.

The exact numbers of tests that have thus contributed to our confidence in the reliability of the stockpile will be provided and analyzed in a classified attachment.* I can summarize some of the information here, however. The number of LASL weapon designs that have been retired from the active inventory over the years exceeds the number of designs now in the stockpile by about 40%. Many of the older weapons were in the stockpile for only a few years, having been replaced by newer designs well before any aging concerns arose. Yet, during their lifetime in the stockpile, there were no fewer than 53 instances in which tests involving either stockpile (War Reserve - WR) weapons directly or the key nuclear components of such weapons, those on which their reliability depends, confirmed the proper functioning of the weapons or components (or, in a few cases, revealed problems with the weapons). The actual number of tests involved was somewhat smaller, because some tests confirmed the reliability of more than one stockpile weapon. For the weapons still in the active inventory the number of such confidence-building incidents is larger: 89. All of these confirmations of reliability have testified to the continued operability of the LASL weapons in the present stockpile. Over 20 of the tests in recent years have involved WR weapons, while the rest have involved the most important (from the standpoint of reliability) nuclear components of the stockpile weapons, and speak directly to the reliability of the weapons themselves. All LASL weapons now in stockpile have had the benefit of at least one, and in most cases several such "reliability tests," as shown by weapon type in the attachment.*

*The data in the classified attachment is included as part of the total data in Table I of this report.

It is, I believe, generally understood that modern weapons have become more sophisticated and safer, less vulnerable to hostile environments and to terrorist activity, and more constrained by economic and delivery system requirements. As the duration of their retention in the stockpile has grown compared to that of the earlier weapons, the number of tests that, among other things, demonstrate their continued reliability has naturally also grown. This signals a special problem in connection with the newest designs now entering the stockpile, replacing older weapons and providing new capabilities. There simply does not exist a backlog of reliability test experience with those weapons to attest to their reliability five, 10, 20 years hence. If testing continues, past experience suggests that in the normal course of events such a data base will be developed for each of the new weapons, as it has for the present stockpile. Without testing this will not happen. Further, problems that may develop will not be disclosed by testing, as they sometimes have been in the past. Combined with the erosion of our expertise, this will seriously jeopardize our long-range confidence in the reliability of some of the most important strategic systems in the U.S. arsenal.

I hope that these facts will contribute to a better understanding of the essential role testing has played in maintaining our continued high level of confidence in the reliability of the nuclear weapons in our stockpile, and of the necessity for continued testing in the future so long as we depend on these weapons for our security and that of our allies. We have established within the nuclear weapons community what the minimum necessary level of testing would be for the narrowly defined purpose of maintaining the stockpile. Without the minimum testing that is necessary we will either lose confidence in the long run, or be lulled into false confidence without knowing that it is false. Neither result, in my view, would be acceptable.

Sincerely,

Harold M. Agnew
Director

TD-9:78-6

January 25, 1978

Cyclotol vs 9404

Implosion systems were developed during 1957-58 for the W30, B41, B53, W53, and W52. [redacted] DOE b(3)

During the 1958-1961 Moratorium two accidents involving the explosive 9404 occurred at Los Alamos. As a result, the laboratory decided to discontinue use of this explosive in systems of large size [redacted] and to substitute the less sensitive and less energetic explosive cyclotol in its place. DOE b(3)

[redacted] DOE b(3)

New pit designs were released in 1960 and 1961 and pit FPU dates occurred during 1960-1962. Nuclear testing was resumed underground at NTS on 9/15/61. [redacted]

[redacted] DOE b(3)

In addition to the above six examples of U.S. problems connected with the moratorium, there have been many post moratorium design problems that were only discovered through nuclear testing. Those connected with nuclear design will be covered in a separate memo. We are, however, including six examples of vulnerability and effects problems that have only been revealed by nuclear testing.

Proposed Paragraph for Executive Summary

Experience has shown that our warheads and reentry vehicles must survive in hostile environments that frequently change as our perception of Soviet defense capability improves. Weapon effects tests at NTS are used to assess the reliability of our warheads against these evolving enemy defenses. The experiments have revealed major deficiencies in our designs and allowed corrective measures to be taken. Many of the defects were unexpected and could not have been revealed except by full scale testing. Because we made corrections, we have an increased confidence in the ability of our tested systems to perform their required missions. In attack scenarios, x-ray fluences are too high for simulation except with a nuclear weapon as the source. Although many neutron attack scenarios can be simulated using pulse reactors, other engagements involve neutron pulse widths that are orders of magnitude too narrow for any foreseeable pulse reactor to simulate. Thus we have to this time been quite dependent upon nuclear testing to display the Achilles' Heels of the survivability of our weapon systems.

Discussion

In our support of Phase 3 programs (especially), it is clear to those who do V & E work that the using services do take survivability seriously. They consider assurance of a design yield under benign conditions necessary but not sufficient.

It is true that we know a great deal about the physics of neutron and x-ray interaction with materials; so also does TD-Division know how bombs work.